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MATHEMATICAL APPROACH TO THE EVALUATION AND PLANNING OF INFLUENCE OPERATIONS

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Content

Figures and Tables

1.0 FUNDAMENTAL GOAL OF THIS RESEARCH.

This report describes research that aims to create a capability to quantitatively predict the results of influence operations. This research intends to meld mathematical methods from operations research, market research, psychology, sociology and economics to produce useful tools for the quantitative assessment of influence operations. The work is substantially interdisciplinary since it entails a cooperative endeavor of mathematically oriented scientists with specialists from market research, psychology, sociology, and economics.

While the focus is on building useful mathematical structures, the intention is to apply these structures to actual combat data (after action reports) in the setting of influence operations.

2.0 WHAT IS INCLUDED UNDER INFLUENCE OPERATIONS?

According to U.S. Air Force Concept of Operations for Information Operations, Influence Operations "employ capabilities to affect behaviors, protect operations, communicate commander's intent, and project accurate information to achieve desired effects across the targeting domain. These effects should result in differing behavior or a change in the adversary decision cycle, which aligns with the commander's objectives." [1] Specific events involved in Influence Operations are Psychological Operations (PSYOP), military deception, counterintelligence, and public affairs functions aimed at foreign populations.

Military activities falling under the category of influence operations include: use of posters, leaflets, local acoustic broadcasts, radio transmissions, television information reports, and newspaper articles targeted on foreign populations.

Use of kinetic weapons to warn or intimidate an adversary may also be included under influence or information operations.

Loud sounds and other disturbing sensory inputs may deprive the enemy of rest or sleep, and these activities may also be considered information or influence operations.

Application of high power microwave devices to disrupt the functioning of radar or other electronics-based systems can also be considered influence operations or information operations. These activities deprive the adversary use of systems needed for defensive and offensive actions.

3.0 THE ROLE OF MATHEMATICS IN THIS RESEARCH.

Since the goal of this work is to quantitatively predict the result of influence operations, an important component of this research is the use of mathematical and statistical tools. While applying existing mathematical tools in new ways to address influence operations is expected, it is also important to be alert to the possibility of inventing new mathematical tools if the task requires this.

3.1 Mathematical Methods Used in Program

This research will apply the following mathematical methods and tools:

(a) Mathematical methods from operations research for the representation of military conflicts, that is, combat models and other quantitative combat assessment tools. (Lanchester models in this category are described shortly below)

(b) Statistical models from market research for the purpose of describing human behavioral responses to received messages and other experiences stemming from influence or information operations.

(c) Learning theory models from psychology for the purpose of examining the structure of market research and their statistical models.

(d) Equilibrium and dynamical econometric models to represent intra-group and inter-group competition and the effect of economic conditions on the susceptibility of populations to externally applied influence operations.

3.2 The Use of Combat Metrics.

A fundamental need in this research is to have <u>a metric of a successful influence operation</u>. The success of an influence operation activity is best measured by American success on the battlefield - <u>measured as decreases in American casualties and materiel loss in the setting of increased rates of enemy defeat (measured as enemy casualties and materiel loss)</u>.

Because the measure of success for influence operations used in this research is a military measure related to personnel and materiel losses in a combat setting, this effort must attend to combat modeling and other quantitative combat assessment tools.

The combat modeling and assessment tools that need to be used include Lanchester models, discrete task event analysis tools, dynamical models for the representation of human behavior, and hybrid models.

3.2.1 Lanchester Models.

This classical approach to considering encounters between adversaries is useful for first approximations of effect. Both deterministic and stochastic forms of the Lanchester model format have been developed and can be applied in this effort [2, 3].

3.2.2 Discrete Task Event Analysis Tools.

These tools are well known in operations research, and standard computer packages are available to assess complex military settings such as an integrated air defense [4, 5]

3.2.3 Dynamical Models for the Representation of Human Behavior.

These models are extremely mature when applied to personnel flying performance and military weapon aiming tasks [6].

3.2.4 Hybrid Models.

Combat models that combine discrete event simulation with continuous dynamical system representations of weapons will be used. For example, the decision to launch a cruise missile may be seen as a network of discrete tasks, but the flight of the cruise missile to the target is governed by a set of ordinary differential equations.

This mathematical structure, which combines task networks with families of ordinary or partial differential equations, is one area of research where new mathematical results may be achieved.

A simple example of such a system is provided below:

Consider a harmonic oscillator with an initial potential energy. That is, consider

$$\frac{d^2\phi}{dt^2} + a\frac{d\phi}{dt} + b\phi = 0$$

with $\phi = \ell \quad at \quad t = 0$. Further, consider that the viscous coefficient *a* takes three values *-v, 0, +v* at regular time intervals, which are short compared to the natural period of the oscillator, and that the viscous coefficient *a* takes these values in accordance with a Markov process with *a=0* at t=*0.*

What is the expected value at a time greater than zero of the trajectory of this dynamical system? What are the statistics of this system's behavior? While these answers may be obtained readily through brute force computer simulation, a deeply interesting mathematical question is whether anything can be said analytically about systems of this nature.

Problems like the one just described have been addressed in the mathematics literature for the case when the viscous coefficient *a* is a continuous stationary stochastic process [7, 8]. <u>The mating of Markov discrete state processes and ordinary or partial differential equations is not well documented in the mathematics literature, but is commonly encountered in combat assessment work</u>.

This example is analogous to aircraft control with the aircraft receiving intermittent inputs from pilot action on a joystick.

3.3 The Role of Market Research Data and Experience

Attempts by private corporations, political parties and the Government to influence the behavior of people are evident in today's society. For example:

- Corporate activity is seen in advertisements through television, newspapers, radio, and billboards.

- Political Parties use various announcement modalities during political campaigns (political advertising).

- Government activities include public service announcements, such as anti-smoking campaigns.

Whether pursued by corporations, political parties, or by the Government, these examples illustrate influence operations for non-military purposes and are covered by the discipline of market research.

3.3.1 Applicability of Market Research to Influence Operations

Both market research, as a discipline, and influence operations seek to alter behavior in human beings through messaging by systematically gathering, recording, and analyzing data. It is, therefore, meaningful to use the principle and practices of market research in the assessment of military influence operations. Although the methods or procedures of market research will not carry over exactly into the military setting, the large literature and experience base associated with market research can provide important indications of techniques and approaches that may be useful in military influence operations.

3.3.2 Example Model

In this section, an example of a market research statistical model that may carry over successfully to the military influence operations setting is illustrated. As will be illustrated in section 4.0, this kind of market research or market science model can be tied into combat models to estimate the effect of influence operations on mission outcomes. This example refers to an article by Jones and Zufryden titled "Adding Explanatory Variables to a Consumer Purchase Behavior Model: an Exploratory Study" [9]. Let the variable p refer to an individual's proclivity to purchase a specific marketed item. Jones and Zufryden consider that this proclivity or probability to buy is distributed within the market or within the market segment according to a beta distribution:

$$f(p \mid m, n) = \frac{\Gamma(m+n)}{\Gamma(m)\Gamma(n)} p^{m-1}(1-p)^{n-1}$$

The symbol $\Gamma(y)$ refers to the Gamma function. The mean of this distribution is considered variable while the variance is considered fixed. The mean of this propensity distribution is considered effected by advertising and other influences according to the logistic relation. That is,

$$\log\left[\frac{E(p)}{1-E(p)}\right] = \beta_0 + \sum_{i=1}^{N} \beta_i x_i$$

The symbol *E* refers to expectation, and the β symbols refer to coefficients determined from data. These market science models are estimable in that the coefficients, as stated, are unambiguously determined from data. Furthermore, these models can be well fit to relatively small sample sizes (less than twenty individuals) and have been found predictive of group behavior [9, 10, 11, 12].

The covariates in the above model, and other similar market research models, include features such as advertising exposure duration, advertising modality (radio, TV etc.), and demographic variables such as gender and age of the target person.

The hypothesis in this research is that statistical distributions, that have been proven useful with purchasing behavior in market research, may also have utility when it comes to choice behavior concerning military activity. Specifically, it is likely that beta, or similar distributions, capture the dispersion of proclivities toward particular military activities in a community. In a similar manner, the logistic relationships are good candidates to relate probabilities to expected values.

This hypothesis concerning the partial transferability of market research concepts to influence operations is testable or falsifiable. For example, a sequence of after action reports can be assessed as a time series that may be dependent on intermittent, concomitant influence operations. Relationships between influence operations and military activity can be inferred using statistical models such as those sketched above. If the models fit well, they may have predictive utility that can be checked within available combat data streams.

3.4 Learning Theory Considerations

The models provided by market research are empirical in that they statistically fit to collected data, and goodness-of-fit analyses suggest they are descriptive and predictive of group outcomes. However, these market theory models are not derived from an underlying understanding of human behavior; they are data-based, empirical fits. The recommended research intends to continue this empiricism in the setting of military action report time serial data.

When advertising or information operations affect behavior, a kind of learning has occurred within individuals and communities. Therefore, an additional goal of the work proposed here is to try to <u>develop a theoretical underpinning for the empirical models used in market research and market science</u>. Part of that theoretical underpinning is expected to come from mathematical psychology as applied to learning theory.

Three fundamental factors that determine whether an influence operations campaign will actually change behavior within a community are: (1) the spread of the message, (2) message retention (memory), and (3) message incorporation.

3.4.1 Spread of the Message

One factor is the spread of the message within the community. The spread of a message has a component that is purely physical or logistical; specifically, who has read, heard or seen the message. The spread or diffusion of the message is in space and time and depends on available modalities such as leaflets, radio, television and word-of-mouth. However, if the message has been retained, or if the message has been internalized (incorporation), there will be an additional boost to the message movement through the community [13, 14, 15]. Therefore, this shows that the spread of the message, message retention and message incorporation are related. Models of message spread within a community need to be used in this effort.

3.4.2 Message Retention

Message retention refers to an activity of human memory and learning and is a matter for mathematical learning theory. Mathematical structures associated with message spread within a community and learning within individuals need to be studied more thoroughly in their application to influence operations. These mathematical structures may be predictive of useful influence operations models, which have been used in market research and market studies. More ambitiously, this research may provide estimates of the coefficients in models, such as the logistic model shown above, and enable comparison of these estimates, derived from basic principles, to coefficients estimated from direct market studies.

3.4.3 Message Incorporation

A message can be retained in memory but does not necessarily influence behavior. A memory prompts behavior when it is invested with meaning (cathected in psychological terms). The determinants of whether or not an individual invests meaning and value in a received and retained message are not fully clear. Some thinkers believe such incorporation involves associating the received message with fundamental and perhaps primitive needs for sustenance, security and identity.

Applications of market research ideas to political science come closest to capturing this role of incorporation. Consider, for example, the various advertising campaigns for or against abortion. These campaigns are directed not only at conveying information but at modifying deep seated behaviors and convictions.

3.5 Mathematical Economics and Econometrics

Equilibrium and dynamical economic theory has much to offer the study of advertising and the related study of influence operations.

There are competing suppliers of information, and any given population is segmented with respect to its susceptibility to advertising or other influence. That is, information demand is spread unevenly across a community. In the political setting, one would say that any population is divided up into constituencies. In market research, the term is market segmentation.

The proposed research will use mathematical economic theory to analyze information dynamics within populations. This analysis needs to include competing information sources and competing information consumers. A careful examination of the relationship between employment (labor market dynamics) and propensity to receive and retain certain critical social-political messages needs to take place. Additionally, the relationship between certain material consumer behaviors and propensities to influence those behaviors needs to be considered.

The simplest model of a capitalistic economy has chaotic solutions. Therefore, it is expected that there will be a great deal of mathematical structure and richness arising out of an examination of information supply, demand and competition within communities.

Econometric models need to be applied. This application is necessary since competing interests and competing suppliers have been noted in market research and market science efforts. Various statistical models have been fit to data (such as the logistic models) capturing these effects. Market research has demonstrated that competition is a very important determinant of the success of advertising campaigns. This is particularly noteworthy in political campaigns [16, 17].

4.0 PROPOSED RESEARCH STRUCTURE

4.1 Project Structure

Figure 4.1 shows the structure of this proposed research.

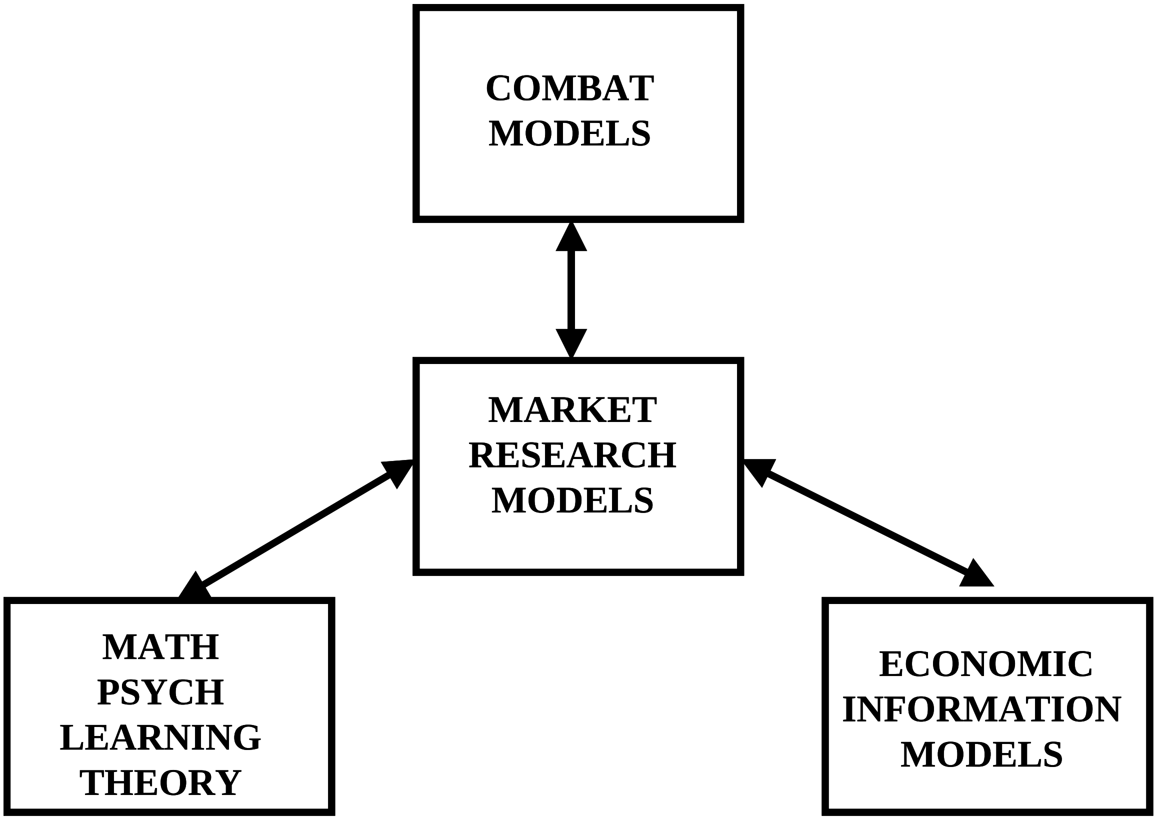

Figure 4.1 Project Structure
This figure provides a schematic of the fundamental work components in this report.

As discussed in the prior section, market science or market research models embedded into combat models will help to quantitatively predict the effect of influence operations on military outcomes. In addition to the market research models, mathematical psychology learning theory (theory of learning curves/theory of extinction curves) needs to be used to estimate, a priori, the form of market research influence equations and the magnitude of coefficients used. Finally, the economic theories need to be used to predict the interactions between competing interests.

4.2 Work Already Accomplished

Work already accomplished provides a glimpse into the kind of product that can result from this research.

As a start, work has been done in the setting of the Lanchester models and considers a blue on red force scenario. The equations for this situation are:

$$\frac{dB}{dt} = -vR$$

and

$$\frac{dR}{dt} = -cB .$$

These equations simply say that the rate, at which the size of the B (R) force decreases, with respect to time, is a function of the size and effectiveness of the opposing force. This set of simultaneous equations has the following solutions:

$$B(t) = (1/2\sqrt{c})\left\{\left(\sqrt{c}B_0 + \sqrt{v}R_0\right)e^{-\sqrt{cv}\,t} + \left(\sqrt{c}B_0 - \sqrt{v}R_0\right)e^{+\sqrt{cv}\,t}\right\}$$
$$R(t) = (1/2\sqrt{v})\left\{\left(\sqrt{c}B_0 + \sqrt{v}R_0\right)e^{-\sqrt{cv}\,t} + \left(\sqrt{v}R_0 - \sqrt{c}B_0\right)e^{+\sqrt{cv}\,t}\right\}$$

These equations simply express the concept that both forces experience attrition $\left(\sqrt{c}B_0 + \sqrt{v}R_0\right)e^{-\sqrt{cv}\,t}$, but one force will lean toward survival and the other annihilation, depending upon the expression $\left(\sqrt{c}B_0 - \sqrt{v}R_0\right)e^{+\sqrt{cvt}}$.

Examining these solutions, it is apparent that an overall summary, statistic or metric for a combat setting, involves the expression $\left(\sqrt{c}B_0 - \sqrt{v}R_0\right)$. In this expression, B_0 is the initial blue force size and R_0 is the initial red force size. The coefficient c is the blue force fighting force efficiency and v is the red force fighting force efficiency. These coefficients have been estimated from data for various military encounters. The fighting force efficiency coefficients are a function of factors such as circular error probability, weapons range, and firing repetition rate.

In a given military encounter, whenever $\left(\sqrt{c}B_0 - \sqrt{v}R_0\right) > 0$, blue force will have won. When $\left(\sqrt{c}B_0 - \sqrt{v}R_0\right) < 0$, the blue force will have lost.

Influence operations can affect the metric $\left(\sqrt{c}B_0 - \sqrt{v}R_0\right)$ in two ways. Influence operations can modify the fighting force coefficients (*c* and *v*) of the opposing sides, and influence operations can influence the frequency or propensity for encounters with differing metrics to occur.

Thinking of a Middle East setting, the blue force was involved with three military encounters: ambush by insurgents, search and destroy counter-insurgency operations and set-piece battles with insurgents. The table below (Table 4.1) shows baseline encounter frequencies per month before and after influence operations.

Changes in encounter frequencies *E(p)* were estimated using the logistic model shown above. Beta coefficients for this equation were obtained from empirical market research studies in the United States addressing sales of consumable objects. The assumption is that, after successful influence operations are implemented, community cooperation will be increased – resulting in decreased ambush activity, increased search and destroy counter-insurgency activity, and a decrease in set-piece battles. The estimates shown here can be considered, at best, order-of-magnitude estimates.

Table 4.1			
	Ambush	**Search and Destroy**	**Set Piece**
Before IO	0.100 (3/30)	0.333 (10/30)	0.0333 (1/30)
After IO	0.0761 (2.3/30)	0.4030 (12/30)	0.0318 (0.95/30)

Table 4.1 Monthly Military Encounter Rates Before and After an Influence Operation

As indicated, the market research logistic model is used to refer to average community reporting activity in the Middle East. Increased community reporting/cooperation is assumed to reduce ambush frequency, increase the number of counter-insurgency offensive missions possible, and decrease the likelihood of set-piece battles.

How does one know that advertising coefficients derived from an American experience, with consumable objects, apply at all to a Middle Eastern setting? At this stage in the research, it cannot be assured that the coefficients will apply in the Middle East with respect to military activities. In fact, one would propose that the coefficients would not apply simply because military behaviors are vastly different from consumption behaviors. However, the hypothesis of this research is that the form of the equations will be useful with respect to military behaviors while the coefficients differ. This hypothesis is testable or falsifiable given existing military data sets.

Finally, examining market research and political science data, the range of possible coefficient values is not extremely large. The beta coefficients used in this exercise took the values -0.3 for ambush, +0.3 for search and destroy missions, and -0.05 for set piece battles. Based on a review of existing logistic model fits, it appears unlikely that military influence operations would have coefficients much greater or less (for example, by a factor of ten) than the range experimented with here. To go beyond the range of known beta coefficients exceeds the efficacy of current known marketing or political advertising efforts. Thus, using coefficients derived from available sources is perhaps being conservative in estimation.

Using the Lanchester equation estimates for these military encounters, blue and red force monthly casualty rates were computed and are shown in Tables 4.2 and 4.3 below. Admittedly, this analysis is informal and approximate.

Table 4.2			
	Ambush	**Search and Destroy**	**Set Piece**
Before IO	4.5	23	7.9
After IO	3.4	28	7.5

Table 4.2 Blue Force Loss per Month Before and After Influence Operations

Table 4.3			
	Ambush	**Search and Destroy**	**Set Piece**
Before IO	0.02	250	119
After IO	0.01	302	113

Table 4.3 Red Force Loss per Month Before and After Influence Operations

The effect of influence operations is unlikely to be just an effect on the frequency of military encounters based on greater or lesser community cooperation. Further, additional important issues concern influence operations and community support for ambush prevention and the relationship of information flow to improved counter-insurgency. Influence operations will also, in all likelihood, change the fighting force coefficients *c* and *v*, and this has not yet been treated. The suggestion is that discrete event modeling tools can provide initial estimates for these additional effects of influence operations.

All these limitations and others do apply. However, the important point, which is believed to be determinative, is that all the equations used have coefficients that are estimable from data and the model fit or lack of fit can be rigorously determined in the setting of real data (after action reports). In other words, these results are falsifiable, and it is this property that makes them of potential value.

4.3 Model-Data Fitting

There needs to be a commitment to develop and use mathematical structures that are estimable and which provide the opportunity to perform rigorous goodness-of-fit analyses. Estimability refers to the property that model coefficients are uniquely determined by data. Goodness-of-fit testing examines the errors between models and data and accepts or rejects the model form based on the statistics of these errors (whiteness and variance). Estimability and goodness-of-fit relate to the falsifiable status. Perhaps more important is the process of fitting models to data and testing them on independent sets.

4.3.1 Practical Aspects of Model-Data Fitting.

In the month of August 2004, there were approximately 2,500 reported military events in Iraq. After-action reports need to provide indications of date and time, force sizes, weapons involved, and conflict category (ambush, counter-insurgency, set-piece, and other). This temporal sequence of encounters and outcomes can be related to prior influence operations, and statistical associations between encounter frequencies and outcomes can lead to coefficient estimates. The fitted models can be recursively updated through time and can be tested (goodness-of-fit, prediction precision and accuracy) on subsequent or prior sequences of after-action reports. When tested favorably, as in the case of market research models, fitted influence operations models can be used as an element in operations decisions and assessment.

The proposed research goal is to take this path of recursive model fitting and integrate this fitting to real after-action report data, with and without contemporaneous influence operations. The goal is to have something substantial and useful to operations within one year of program start.

There is recognition that the use of actual data will render some of the products of this research militarily sensitive and therefore perhaps not publicly releasable. However, the basic mathematical structures need to be reportable in the open literature.

4.3.2 Applying Learning Theory and Econometric Models to Market Theory

The reader may wonder or ask, “Why add learning theory considerations and econometric models to the market theory models?” There is agreement that the task of fitting after-action reports to data can be fully performed in an empirical manner using market science models with combat models. However, there is a deeper understanding of data patterns required beyond the descriptive, and the learning theory approach and econometric methods can provide this understanding. Further, the use of more basic model structures will result in models that are more parsimonious in having fewer coefficients. Also, <u>more basic models may have coefficients that can be estimated from independent sources so that new military scenarios (battle planning in new theatres) can be addressed</u>. Although this approach is reductionism and ambitious, the likely payoff intellectually and practically is worth the effort and risk.

5.0 DETAILS OF RESEARCH ACTIVITIES

5.1 Combat Models.

Initially, there will need to be an emphasis on the study of military encounters now occurring in Afghanistan and Iraq. Then there will need to be a study of optional approaches to modeling these events that, for now, have been categorized into ambush, seek and destroy counter-insurgencies, and set piece encounters. Although the Lanchester models are simplistic, the rich literature that has developed around this format should not be ignored. In addition, there needs to be an exploration of discrete event, dynamical and hybrid formats as estimable representations, with interactions of market science inputs.

Interaction with elements in Air Combat Command (ACC) has emphasized the importance of Integrated Air Defense (IAD) models. Studying the impact of influence operations will be most useful.

The models need to be fitted to after-action reports and, once fitted, will then need to be tested on independent post or prior sequences of after-action reports. Coefficient estimates and goodness-of-fit testing needs to be accomplished.

5.2 Market Research/Market Science Models

A survey of market research/market science models and their application within the American economy has been performed. This survey needs to be summarized and extended to market research in other countries and cultures. A catalog will also need to be developed and will consist of model forms and model coefficients for the different market segments and products offered.

5.3 Learning Theory

Can present understanding of message penetration into communities and learning/information acquisition theories explain the structure of market research models? Although this answer is currently unknown, this question will help guide the performance of applied mathematical research to determine the answer.

5.4 Mathematical Economics/Econometrics

A study needs to be performed consisting of the dynamics of competing interests and competing influence messaging within communities. From studying after-action reports, there will need to be an association of military outcomes with American influence operations. However, this work needs to be done attempting to capture the influence activities of adversaries so that competitive interactions can be considered. There needs to be further study of the content of local broadcasts and news media, in addition to the content of Friday mosque services that have proven to be highly indicative of adversary intentions [18].

5.5 Team Development

The research team suggested involves the following disciplines:

- Lead Scientist
  - Mathematics background
  - Military operations research experience, statistics, econometrics
- Research Assistant
  - Apply market research to influence operations.
  - Provide research support for marketing research models, learning theory models, econometric models, and combat models
  - Analyze research
- Psychologist (Learning Theory)
  - Design and development of advanced training technologies
  - Performs instructional systems design & development, training requirements analysis, training evaluation, performance evaluation.
- Computer Scientist
  - Statistical Analysis
  - Database expertise

- Influence Operations Subject Matter Expert
    - Experience in intelligence and operational research and analysis
    - Information operations knowledge in operational planning, intelligence/information operations analysis, and assessment/measures of effectiveness/intelligence gain-loss
- Political Science/Market Research/Market Science Specialist
    - Acquires data by paneling methods or by polling methods in non-Western cultures
    - Supplies historical context
    - Fits statistical models to real data
    - Adapts statistical models and data to different cultures (i.e. Iraq)
    - Analyzes data and be familiar with alternative models of social segmentation and social group interaction with specific emphasis on economic dimensions
- Psychologist/Sociologist
    - Experience as a research psychologist, research scientist, and psychometrician
    - Statistical research and statistical trend analysis
    - Analysis of variables such as race, economic background, etc.
- International Relations
    - Air Force influence operations and intelligence expertise
    - Activity & data modeling
    - Computer aided system engineering tools and statistical analysis

Table 5.1 below provides estimates the degree of involvement of the above listed disciplines in the proposed research tasks.

Table 5.1 Research Task Involvement						
	Military Models	Market Research Models	Learning Theory Models	Econometric Models	Review of Iraq/ Afghanistan Theatre After-Action Reports	Data Fitting to After-Action Reports
Lead Scientist	++++	++++	++	++++	++	++++
Research Ass.	+	++++	++	++++	+	+++
Psychologist (Learning Th)	++	++	++++	++	++	++
Comp. Scien.	++	++++	+	++	+++	++++
IO SME	++	++	+	++	++++	++++
Mkt Research	++	++++	++++	++++	+	++
Psychologist/ Sociologist	+++	++++	++++	++++	++	+++
Int'l Relations	+++	+++	++	++	++++	++++

+ Person has cognizance only
++ Person oversees the task
+++ Person is a substantive contributor on the task
++++ Person has full responsibility on the task

Table 5.1 Estimates of Person Involvement

This report describes very basic and high-risk exploratory research adapted to a pressing, real-world current problem. Since after-action reports are classified for evident reasons, the model fits to these after-action reports and predictions in light of the model fits will also likely be classified. Achievement of open literature peer review needs to be done by publishing sanitized data within the open literature.

5.5.1 Research Products

The proposed research will result in the following products and deliverables:

5.5.1.1 Review of Existing Models

A complete review of existing models needs to done in four steps. First, reviewing all categories of military operations models and defining whether and how market research statistical models can interact in a positive manner needs to be done. Second, a mechanism for the statistical review of after-action reports in preparation for model fitting, as a function of influence operations, using the existing Lanchester model/logistic format needs to be established. Data fits and predictions need to be made in the beginning, and these data fits and predictions need to be carefully tested for goodness-of-fit and for predictive accuracy and precision. Third, an examination of the relationship of learning theory to market research models needs to take place. Finally, there will need to be an examination of equilibrium and dynamical economic models as they may apply to information competition.

5.5.1.2 Development of an Integrated Air Defense (IAD) Model

A full, integrated air defense model (IAD), with treatment of influence operations effects, needs to be completed. Influence operations parameters need to include high power microwave degradation of IAD computers and displays, jamming activities, kinetic and non-kinetic influences on sleep/wake schedules of IAD operators, and background poster, radio, television influence operations.

5.5.1.3 Integrated Battle Field Assessment

An integrated battlefield assessment from the point of view of influence operations needs to be performed. A mix of encounters including ambush, search and destroy, set piece, and air defense needs to be examined. The problem of optimizing influence operations needs to be addressed in order to determine what influence modalities bear most fruit based on the threat and what level of investment in influence operations will yield the most gain.

At the conclusion of this effort, there will be a quantitative or semi-quantitative influence operations capability in place that is analogous to market research and economic theory as it is practiced today. Additionally, a handbook needs to be developed in order to help guide others who may be working with after action reports and designing influence operations. The capability needs to be set in place at the end of this effort and should permit analysis of the utility of new influence operations modalities as they are developed.

6.0 SUMMARY AND CONCLUSION

This technical report presents the concept that modern market research tools, applicable in Western economies, may be useful in the assessment of influence operations pursued in cultures that are non-Western.

The coefficients in market research models developed in Western economies are not expected to carry over into other cultures. However, the statistical tools that yield those coefficients may work well in non-Western settings.

This technical report also observes that market research structures can be interacted with classical operations research military operations and combat models. Thus, the union of market research statistical models and operations models seems to be a potentially fruitful combination.

An advantage of using market research statistical models with military operations models is that these models can be fitted to existing after action report data and records concerning influence operations. The proposed methods hold the promise of providing an objective assessment of the efficacy of influence operations.

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